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(54) FIBER-OPTIC TERMINATION AND CONNECTOR ARRANGEMENT USING SAME

(71) We, ITT INDUSTRIES INC., a Corporation organised and existing under the laws of the State of Delaware, United States of America, of 320 Park Avenue, New York 22, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to an optical fibre connector in which the fibre ends to be joined are each sealed into a cylindrical sleeve. The fibre ends may not be accurately centred in the sleeves each of which can be rotated about its axis. Each such sleeve is so supported in the eccentric cylindrical bore of a cylindrical connector sleeve, that the axes of the two sleeves extend parallel to one another.

Such a connector is known from the German Offenlegungsschrift (DT-OS) 24 57 165, especially from Figure 4 thereof. Mutual alignment of the fibre ends to be joined is effected in the known arrangement in that each fibre end can be turned in a double eccentricity about the axis of an outer sleeve. This outer sleeve has an eccentric axial bore in which the inner sleeve, i.e. the end of fibre sleeve, is rotatably supported, and the fibre core is sealed eccentrically into the end-of-fibre sleeve. Thus it is possible to align the optical axes of the fibre ends to be joined, but usually they do not coincide with the common centre axis of the connector sleeves connected to one another in proper alignment. This has the disadvantage of requiring readustment after each parting and reestablishment of the connection. Where the eccentricity of the fibre with respect to its end-of-fibre sleeve is the same as that of that sleeve with respect to the connector sleeve, the optical axes of the fibre ends can be adjusted with respect to the centre axis of the connector sleeves, so that they, when fixed in this position, are exactly aligned each time the connection is reestablished.

Moreover, a surface bearing of the end-of-fibre sleeve without any play inside the connector sleeve needs high processing accuracy, so that except for laboratory applications, such a solution is seldom suitable for use.

It is an object of the invention to provide an optical fibre termination and connector arrangement of the kind mentioned above, in which the abovementioned disadvantages are minimised or overcome.

According to the present invention there is provided an optical fibre termination, wherein the end of the fibre is sealed into a cylindrical end-of-fibre sleeve, wherein the end of fibre sleeve is so supported in an eccentric cylindrical bore of a further cylindrical sleeve that the axes of said two sleeves extend parallel to one another and wherein the end-of-fibre sleeve is supported within said eccentric bore by a separately rotatable ball or roller cage having at least three balls or rollers of which at least one has a diameter differing from that of the other balls or rollers so that the axes of said sleeves may be shifted with respect to one another by the relative rotations of said sleeves one to the other.

According to the present invention there is also provided an optical fibre corrector arrangement wherein two terminations each of which is as set out in the preceding paragraph are mounted within a cylindrical bore in a common cylindrical sleeve so that by relative rotations between said further sleeves the optical fibres thereof can be accurately aligned, thus overcoming the effects of axial misalignments of either one of said fibres.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:–

Figure 1 is a cross-section through a connector sleeve for a connector embodying the invention;

Figure 2 is a longitudinal section taken through the connector sleeve of Figure 1;

Figure 3 shows the entire connector partly in a longitudinal section; and

Figure 4 shows one form of the connector receptacle of Figure 3, in cross section.

Figure 1 shows a connector sleeve 1 having a circular outer cross section 2. Inside an eccentric bore 3 in the sleeve, there is a cylindrical end-of-fibre sleeve 4 with a sealed-in fibre 5 whose fibre core 6 is usually eccentric in relation to the centre point F of the cross section of the end-of-fibre sleeve 4. This sleeve 4 is supported inside the bore 3 of the connector sleeve 1 by a ball or roller cage 7. A minimum of three balls or rollers 8 is required in one plane. By means of the ball or roller cage 7, these three balls or rollers 8 are uniformly distributed along the circumference of the bore 3, and kept at equally spaced relations. When using a roller cage, and when the rollers can be long enough in relation to the jacket length of the end-of-fibre sleeve and the connector sleeve, it is sufficient to provide three rollers. When using a ball cage, likewise three balls have to be provided for along the jacketing surface, in two parallel planes as is shown in Figure 2. At least one roller or one ball 8 has a diameter differing from that of the others in the same cross sectional area, so that always the centre point F of the end-of-fibre sleeve is shifted with respect to the centre point B of the bore 3 of the connector sleeve.

In this arrangement the connector sleeve 1, the roller or ball cage 7, hereinafter briefly referred to as the 'cage' and the end-of-fibre sleeve 4 can be moved in relation to one another. This means that there are two degrees of freedom for the adjustment, because one part as a reference part is always to be considered as fixed. Thus the optical axis of the fibre can be shifted within a relatively large range and arbitrarily parallel to its axis, so tha the fibre core 6 can be brought into congruence with the centre point of the connector sleeve, as in Figure 1. Now the optical axis of the fibre end is identical to the axis of the connector sleeve. This adjustment is performed under a microscope.

In Figure 2 one of the connector sleeves is shown in a longipudinal section. The end of the fibre 5 is led into the end of fibre sleeve 4. By surface grinding and polishing care is taken that the end faces of both the sleeve 4 and the fibre 5 form mne sivvle plane. Between the end-of-fibre sleeve 4 and the connector sleeve 1 there is the ball cage 7 with three balls 8 at both its front and rear end. In the chosen longitudinal section, the lower ball is each time in the plane of the drawing. The cross sectional area at the upper rim of the sleeve 1 is distinctly larger than at its lower rim portion, as the axial bore in the connector sleeve 1 intended to receive the end-of-fibre sleeve 4, which as already mentioned, is eccentric. In the outer circumference of the connector sleeve 1 there is a retaining groove 9 in which a spring of the connector may be permitted to engage, as will be explained hereinafter with reference to Figure 3. For mutually fixing in position the movable parts, such as the connector sleeve 1, the cage 7 and the end of fibre sleeve 4, a grip sleeve 10 is provided at the rear end of the connector sleeve 1.

This grip sleeve 10 has threaded bores and screws 11, 12 and 13, Spaced 120° apart from each of the screws 11, 12 and 13, and distributed along the circumference of the grip sleeve 10, there are two further screws which, however, are not shown as not lying in the plane of the drawing.

Referring now to Figure 3, which shows the entire connector assembly, the connectors of Figures 1 and 2 are only shown in a side view, whereas the connector receptacle 14 connecting them, is shown in a longitudinal section. A cross sectional view of the connector recptacle 14 is shown in Figure 4.

As already mentioned, the connector receptacle 14 joins the two identically designed connectors described with reference to Figures 1 and 2, to one another such that their end faces will be smoothly applied to one another and the longitudinal axes thereof will be aligned. For this purpose, along the connector receptacle 14, and at an equally spaced relation from the centre axis thereof, there are two bearing rollers 15 and 16 in longihudinal bores in the inside wall of the connector receptacle 14, which project into the interior space thereof (Figure 4). These bearing rollers from a two-line bearing common to both connector sleeves to be joined, so that the longitudinal axes of the connector sleeves as resting on the bearing rollers, will be aligned. The two connector sleeves which are thus supported and guided from both sides into the receptacle 14 are fow held together in the position in which the end faces thereof meet, this being effected with the aid of a flat spring 17 whose ends engage in the retaining grooves 9. This connection, as required, is easily detachable. The flat spring 17 is secured with a screw 18 in the outer surface of the receptacle 14, where from the ends of the spring extend through the bores 19 and 20 into the interior space. If, before mating the two connector sleeves the optical axis of the fibre as positioned therein has been adjusted to the axis of the connector sleeve as described with reference to Figure 1, the ends of the fibres 5 as joined to one another according to Figure 3, will meet against one another, thus safeguarding a low loss transfer of light at the connecting point. The cross section through the connector sleeve 1 itself as shown in Figure 4, exactly corresponds to that shown in Figure 1 and, therefore, does not need to be explained again.

WHAT WE CLAIM IS:–

1. An optical fibre termination, wherein the end of the fibre is sealed into a cylindrical end-of-fibre sleeve, wherein the end-of-fibre sleeve is so supported in an eccentric cylindrical bore of a further cylindrical sleeve that the axes of said two sleeves extend parallel to one another and wherein the end of fibre sleeve is supported within said eccentric bore by a separately rotatable ball or roller cage having at least three balls or rollers of which at least one has a diameter differing from that of the other balls or rollers so that the axes of said sleeves may be shifted with respect to one another by the relative rotations of said sleeves one to the other.

2. An optical fibre connector arrangement wherein two terminations each of which is as claimed in claim 1 are mounted within a cylindrical bore in a common cylindrical sleeve so that by relative rotations between said further sleeves the optical fibres thereof can be accurately aligned, thus overcoming the effects of axial misalignments of either one of said fibres.

3. A connector arrangement according to claim 2, wherein for each of the fibre ends to be joined, there is a grip sleeve containing means for latching with respect to one another the end-of-fibre sleeve, the roller or ball cage and the further sleeve, which are all movable in relation to one another.

4. A connector according to claims 2 or 3 wherein within the common sleeve, which is so designed as to permit the coaxial mating of two connector sleeves, a snap-action device is provided to retain the thus mated connector sleeves in position with the end faces thereof meeting against one another.

5. An optical fibre termination substantially as described with reference to Figures 1 and 2 of the accompanying drawings.

6. An optical fibre connector arrangement substantially as described with reference to Figures 3 and 4 of the accompanying drawings.

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1535499 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

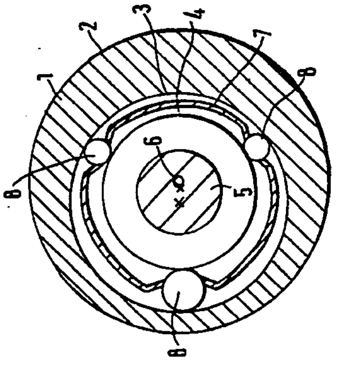

Fig.1.

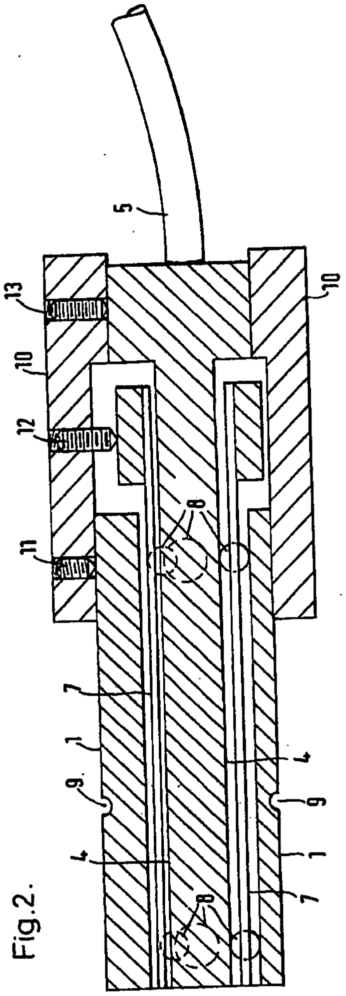

Fig.2.

1535499 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

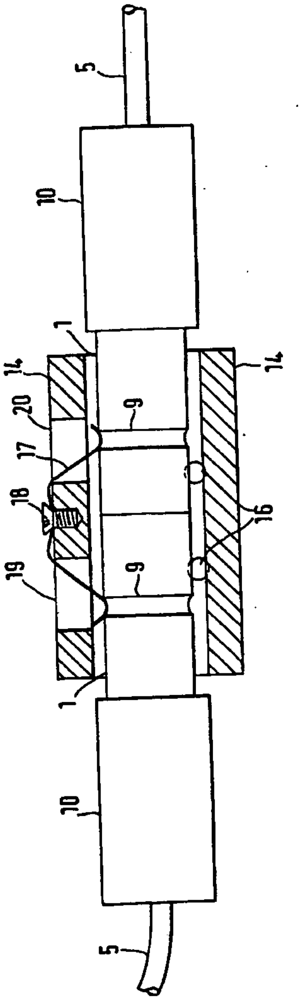

Fig.3.

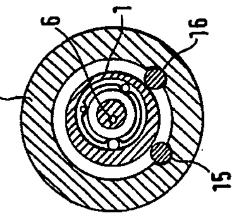

Fig.4.